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### Description

The present invention relates to laminates and, more particularly, decorative laminates having high scuff resistance.

High pressure decorative laminates are conventionally produced by stacking and curing under heat and pressure a plurality of layers of paper impregnated with various synthetic thermosetting resins. In normal practice the assembly, from the bottom up, consists of a plurality, e.g. three to eight, core sheets made from phenolic resin impregnated kraft paper, above which lies a decor sheet impregnated with melamine resin; on top of the decor sheet is provided an overlay sheet which, in the laminate, is almost transparent and provides protection for the decor sheet.

The core sheets are conventionally made from kraft paper of about 90—155 pound ream weight (147—253 g/m<sup>2</sup>). Prior to stacking, the kraft paper is impregnated with a water-alcohol solution of phenol formaldehyde resole, dried and partially cured in a hot air oven, and finally cut into sheets.

The decor sheet is a high quality, 50—125 ream weight (81—204 g/m<sup>2</sup>), pigment filled, alpha cellulose paper that has been impregnated with a water-alcohol solution of melamine, formaldehyde resin, dried and partially cured, and finally cut into sheets. The decor sheet, prior to impregnation with the resin, usually has been printed with a decorative design, or with a photogravure reproduction of natural materials, such as wood, marble, leather, etc, but it may also be solid coloured.

The overlay sheet is almost invariably used when the decor sheet has a surface printing in order to protect the printing from abrasive wear. The overlay sheet is a high quality alpha cellulose paper of about 15—35 pounds ream weight (24—56 g/m<sup>2</sup>) that is also impregnated with melamine-formaldehyde resin in a manner similar to that used for the decor sheet, except that a greater amount of resin per unit weight of paper is used. The individual sheets are stacked in the manner indicated above and, if six sheets of impregnated core paper are used, there results a finished laminate having a thickness of about 50 mils (1.27 mm); it being understood that a different number of sheets can be used to provide thicker or thinner laminates.

The stack of sheets as described above is placed between polished steel plates and subjected to about 230°—340°F (110—177°C) (e.g. 300°F, 149°C) at 800—1600 psi (5.51—10.1 MPa) (e.g. 1000 psi, 6.89 MPa) for a time sufficient to consolidate the laminate and cure the resins (e.g. about twenty-five minutes). This causes the resin in the paper sheets to flow, cure and consolidate the sheets into a unitary laminated mass referred to in the art as a decorative high-pressure laminate. In actual practice, two laminated stacks are pressed back to back, separated by a coated release sheet that allows the two laminates to be peeled apart after separation. Also, a large pro-

portion of the stacks are laminated with an aluminium foil-kraft paper composite sheet inserted between the overlay and the metal plate, with the aluminium facing the overlay, in order to obtain a laminate having a lower gloss and a slightly textured surface which is desirable for some products.

At the completion of the laminated operation, the backs of the laminates are sanded to permit gluing to particle board, plywood or other substrates. The glued laminate surfaced panel is then fabricated into furniture, kitchen counter tops, table tops, store fixtures and other end-use applications widely accepted for the combination of appearance, durability and economy.

A number of variations of the above-described general process are known, particularly those operations designed to obtain special effects in appearance and texture. Also other curing cycles are possible and, in fact, sometimes other resin systems are used as well.

Besides decorative high-pressure laminates referred to above, there are also a number of low-pressure products which have been developed in recent years, including low-pressure laminates using either saturated polyester resins, or melamine-formaldehyde resin. One of the fastest growing materials competing with high-pressure laminates in recent years is a product referred to as low-pressure melamine board which is normally pressed in a short cycle at 175—225 psi (1.2—1.55 MPa) at 325°—350°F (163—177°C). These low-pressure products have the advantage of being normally less expensive, but they cannot be given the title of "high pressure laminates" because such a product must meet a variety of rigid standards promulgated by the National Electric Manufacturers Associates, NEMA LD3—1980, which include standards relating to abrasive wear, stain resistance, heat resistance, impact resistance, dimensional stability, etc. While various other decorative, printed, surfacing materials, such as some of the low-pressure laminates, have certain of the desirable characteristics, no products other than high-pressure laminates currently available have all of these properties.

One of these properties in particular which is very important is abrasion resistance. Adequate abrasion resistance is provided in most cases by the overlay sheet.

Superior abrasion resistance is provided in accordance with the Scher et al US—A—4,255,480 and 4,263,081 and their progeny, and at a lower cost. US—A—4,263,081 describes an abrasion-resistant laminate having an ultra-thin layer of microcrystalline cellulose over-coated with mineral particles.

In some cases, however, such as low-pressure laminates and high-pressure laminates intended for use in low wear areas, such as wall panelling, fairly low abrasion resistance is tolerable. If a high-pressure decorative laminate is prepared in a conventional manner, with a normal 35—40% resin content in the decor sheets, but without an

overlay sheet, the abrasion resistance will be only about 50—75 cycles NEMA test LD—3:01.

Besides resistance to abrasion and wear, it is necessary that decorative laminates, especially "high-pressure laminates", have surfaces characterized by resistance to heat, stain by common household chemicals and foods, impact and boiling water, all consistent with the NEMA LD3—1980 standards.

In addition to the above, another source of damage to a laminate surface is scuffing. Prior to the actual installation of a laminate surface, the laminate sheet must be handled many times, cut to size, bonded to a substrate, cut to final size, edged, and then finally moved to a final location and installed. During all this handling, the laminate surface can come into sliding contact with surfaces of other sheets, corners of sheets, and corners or edges of other materials. During these various sliding contacts, the laminate surface can gain unsightly scuff marks, which are not distinctly scratches or cuts in the laminate surface. For example, if a white coloured laminate is rubbed by the corner or edge of a blue coloured laminate, the scuff mark appears to have blue particles embedded therein. In this sense, the scuff mark is analogous to the process known as "galling" when two similar clean surfaces of metals are rubbed together at high pressure. It is well known to metallurgists that galling represents a transfer of metal from one surface to the other.

Some scuffs do not have an obvious transfer of material from an offending contacting object. In these cases, the area of the scuff appears to have been burnished to a higher gloss, or dulled to a lower gloss. This type of scuff appears to be caused by a very small amount of flow in the laminate surface due to the pressure of contact with the corner or edge of the offending object. Most frequently, however, the scuffs appear to be caused by a combination of the two effects just described, i.e. galling together with burnishing or dulling.

In the past, most decorative laminates were produced in light colours for work tops and other large area uses. Dark or intense colours could not be used in large areas because of the scuffing problem and therefore were most often used in smaller areas for colour accents. Within the past ten years, however, the demand for dark and intense colours has greatly increased, even for large area uses such as the surfaces on store fixtures, elevator cabs, restaurant tables. As scuff marks of the kind described are much more visible when they occur on dark or intensely coloured surfaces, than on light coloured surfaces, they are much more objectionable to the owners of the installation. This has caused a significant amount of customer dissatisfaction, and considerable expense to the manufacturers and fabricators of laminate for replacement of defective installations.

Accordingly, it would be advantageous to provide a decorative laminate which avoids and reduces the problem of scuffing.

British Patent 1598587 describes a bowling lane surface having a resin-impregnated overlay containing an internal lubricant which is incorporated in the resin.

It is an object of the invention to overcome deficiencies in the prior art, such as indicated above.

It is another object to provide improved decorative laminates;

— to develop improved scuff resistance in the surface of decorative laminated plastic;

— accomplish the improvement in an economical manner compatible with the laminating process; and

— not harm other desirable properties of the laminate, and in particular, not reduce the clarity of the colour or decorative printing in the decor layer.

These and other objects of the invention are attained by incorporating suitable lubricating substances into the upper surfaces of the laminates. It has been surprisingly found that the added lubricant provides substantially improved scuff resistance. In other words, it has been found possible to incorporate a lubricant into the upper surface without adversely affecting the physical properties of such laminates.

Another aspect of the invention involves how to incorporate such a lubricant into the laminate surface without reducing the physical properties of the laminate.

The invention can be embodied in two general types of laminates, one type of which is also abrasion-resistant according to US—A—4,255,480; 4,263,081; and other laminates as well, here referred to for convenience as "non-abrasion-resistant" laminates. In this first group, i.e. the abrasion-resistant laminates, it has been surprisingly found that the added lubricant provides substantially improved scuff resistance even though the hard abrasion-resistant particles remain at the laminate surface and continue to provide the enhanced abrasion resistance described in the above-referenced United States Patents. In other words, it has been found possible to incorporate a lubricant into the abrasion-resistant surface without reducing the physical properties inherent in such abrasion-resistant surface. This result is surprising because, particularly on the macroscopic level, it was incorrectly believed that a lubricant would work contrary to the abrasion-resistant particles.

The scuff-resistance of high-pressure laminated plastic is improved by incorporating in or very near the surface finally divided solid wax particles having a particle size of up to 30 microns ( $\mu\text{m}$ ) and a melting point of about 150—285°F (65.5—139°C), preferably not less than 180°F (82.2°C) and with advantage in the range of 220—230°F (104—110°C). It is preferred that the wax should have a particle size of from 1 to 25  $\mu\text{m}$ . The wax is incorporated in a coating mixture applied as an ultra-thin layer (as in the abrasion-resistant coating of the aforementioned US—A—4,255,480 and 4,263,081, except that for the "non-abrasion-resistant" laminates the mineral particles are not used)

to the face of an unimpregnated decor paper sheet, which is dried at a temperature below the wax melting point, and then impregnated with conventional melamine-formaldehyde resin or polyester resin. Such an ultra-thin layer has a thickness of less than 0.5 mils (12.7  $\mu$ m) and preferably in the range of 0.02 to 0.3 mils (0.5—7.62  $\mu$ m) although the thickness is advantageously about 0.05 to 0.3 mils (1.27—7.62  $\mu$ m).

The impregnated sheet is placed onto a suitable backing substrate such as a stack of conventional phenolic resin-impregnated core sheets, and consolidated under heat and pressure. During consolidation, the wax particles "bloom", or migrate to the surface. The finished laminate surface is more slippery than normal, and has greatly improved scuff resistance, whether or not it contains abrasive particles to make it abrasion-resistant. The particle size and concentration of the wax are selected to avoid reducing the colour intensity or clarity of the decorative surface of the decor sheet.

The selection of the lubricant is important to obtain satisfactory results. Thus, the lubricant or mixture of lubricants should be compatible with the other components of the ultra-thin layer as disclosed in the aforementioned US—A—4,255,480, etc, except that if a "non-abrasion resistant" laminate is prepared there is no need for concern regarding compatibility with the mineral particles and silane. Also, the solid lubricant should melt during pressing so that it will bloom to the laminate surface and be locked in without causing haze or deterioration. The wax should melt at a temperature below 260°F (127°C) to avoid haze in the product; however, haze can sometimes be tolerated, and therefore some higher melting waxes can sometimes be used, even though they do not melt during the laminating process.

A large number of waxes have been evaluated having different melt viscosities, melting points, and percents oxidation, in anionic and nonionic dispersions. It has been found that a nonionic type has less yellowing and high melt viscosity gives better dispersion. It has also been determined that lower melting point waxes bloom better and give more lubricity at lower concentration.

It has been also determined that powdered polyethylene can be dispersed in coating compositions used for the ultra-thin layer as an inert material similar to other insolubles without the use of detergents. It has been demonstrated that oxidized waxes work well as a lubricant but are subject to staining on the final laminate.

While it has been found that best results are achieved with fine powder wax, preferably micronized polyethylene wax, a wide variety of other lubricants can be used, depending on the circumstances. For example, it has been found that some lubricants will cause the resultant laminate to have a hazy surface, which result is undesirable in most cases; however, there are some colours in which haze is tolerable. Among

lubricants which are not preferred but which may be used under certain conditions may be mentioned micronized fluorocarbon polymers, tetrafluoroethylene polymer in fine particle size (e.g. SST—2 of Shamrock Chemicals Corporation or "Polyfluor® 190" of Micro Powders, Inc.); stearates, such as sodium and zinc stearates; solid silicone resins; oxidized polyethylene waxes; microcrystalline waxes, ethylene copolymers with acrylic acid or with vinyl acetate, etc. However, as noted above, the preferred lubricants constitute micronized polyethylene waxes, and particularly those commonly used in the formulation of printing inks.

Crucial to producing the best product which is free of haze is to ensure that the lubricant melts during the laminating operation. However, if the lubricant melts at too low a temperature, i.e. at less than 140°F (60°C) or any temperature higher which is used during the drying of the ultra-thin coating, the molten lubricant will tend to wet the fibers of the decor sheet and will thereby cause blotches or a mottled appearance and frosty or greying colour, which is undesirable in most cases, and/or even worse, will interfere or prevent resin saturation of the decor sheet by the impregnating resin (melamine or polyester) thereby resulting in the incompletely bonded laminate, a situation which cannot be tolerated. Also this prevents the wax from blooming, thereby causing relatively poor scuff resistance. When wax is not melted during the drying of the abrasion-resistant coating, it is available to disperse during laminate pressing and "blooms" to the surface. Thus, the wax melting point should be sufficiently low so that it melts and "blooms" at the melting point of the impregnating resin, i.e. melamine or polyester, and before such resin gels.

Higher melting point waxes, i.e. those not melting during lamination, may also cause light scattering and a frosty appearance. It is accordingly important in most cases that a solid lubricant be selected which does not melt during the drying of the ultra-thin abrasion-resistant coating, but which does melt subsequently during the laminating procedure.

For best results, the drying of the abrasion-resistant coating containing the lubricant should be at about 170°—190°F (77—88°C), above the minimum temperature of 140°F (60°C) and substantially below the melting point of the lubricant which is desirably 220°—230°F (104—110°C).

Another important factor is the quantity of lubricant used. In general, the scuff resistance of the resultant abrasion-resistant laminate tends to taper off as the quantity of lubricant becomes less than 3% based on the total weight of the dry components of the abrasion-resistance composition, and therefore a practical minimum is about 2.5% based on the total weight of components of the ultra-thin facing layers, exclusive of the thermosetting resin. Amounts less than 2% give a scuff resistance which in most cases is insufficient. The maximum quantity, again based on the total weight of dry components of the abrasion-

resistance coating, can be 10% or more wax. If too much wax is used, it can result in clouding or haze; excessive quantities can result in a waxy surface failing to meet other NEMA LD-3 requirements. In terms of rate of application of wax, it has been found that excellent results are achieved at the application rate of 0.25 pounds of wax per ream of decor paper (0.4 g/m<sup>2</sup>), and quantities of 0.175 to 0.5 pounds of wax per ream of decor paper (0.3—0.8 g/m<sup>2</sup>) have been used without problem.

The other ingredients of the coating composition, as applied in an ultra-thin layer to the upper surface of the decor sheet, as are described in the aforementioned US Patents, with the exception that the abrasion-resistant mineral particles and the optional silanes are not used when "non-abrasion-resistant" laminates are made. In general, the composition includes a temporary binder material, such as microcrystalline cellulose, carboxymethyl cellulose and similar materials such as hydroxypropyl cellulose, methyl cellulose, polyvinyl alcohol, polyvinyl pyrrolidone, anionic acrylic polymer, sodium alginate and similar materials, etc, and mixtures thereof, so long as such materials are both compatible with the wax and are capable of withstanding the laminating conditions to give a satisfactory product. Sodium alginate has been used with success to make "non-abrasion-resistant" laminates according to the invention, and mixtures of microcrystalline cellulose and carboxymethyl cellulose have been used with success in the invention to make both types of laminates.

The ingredients including the temporary binder or mixture thereof, the solid lubricant particles, the abrasion-resistant particles with or without silane where abrasion-resistant laminate is desired, and water are mixed to form a water slurry of suitable consistency so that it can be cast directly on the surface of the decor sheet as a very fine layer. After the wet layer is formed, it is then dried, it being understood that the drying temperature is a minimum of 140°F (60°C), preferably at least 180°F (82°C), when the binder material comprises microcrystalline cellulose. The calculated coating thickness, after drying, is on the order of 0.02—0.3 mils (0.5—7.62 µm), preferably up to about 0.2 mils (5 µm). Instead of casting the wet composition directly on the decor sheet, it can instead be cast on a temporary carrier, dried and then transferred to the decor sheet during lamination as shown by the technique of the Ungar et al EP-A-0,109,313.

The following Examples and Comparative Examples will further illustrate the invention:

#### Comparative Example 1

High-pressure decorative ARP laminate was made according to the process of Scher et al US-A-4,255,480. After pressing and cooling, it was found that the surface was hard and had a high abrasion resistance and rate of wear according to NEMA LD3-1980. In addition, the superior scratch resistance of the ARP laminate could be

demonstrated by rubbing with flint sandpaper, which when rubbed on ordinary laminate completely destroyed surface gloss and finish. While the sandpaper did not harm the ARP laminate, when the surface was stroked or rubbed with the edge of a light coloured material, it showed signs of scuffing.

In various experiments, soaps such as sodium and zinc stearate were applied to the surface of the laminate. Unfortunately, this technique only supplied temporary improvement. Material washed off easily and the problem returned. Incorporation of these types of materials in melamine used for saturation of abrasion-resistant coated paper did not have any effect until the concentration was so high that the melamine properties deteriorated. Addition of stearates to the abrasion-resistant composition also gave poor results; excessive quantities were needed, and the stearates also, being soluble in water, washed from the surface.

#### Comparative Example 2

Following the technique of the second part of Comparative Example 1, a number of dispersible waxes, especially polyethylene waxes, were incorporated in the melamine resin. These included Allied Chemical's AC629 and Duro Chemical Uniwax® 2000 and 050. We evaluated 2.5%, 5%, 10%, 15% and 20% of wax in resin. In addition, a liquid silicone mold release, Dow QL-3667, was evaluated in the melamine. As before, improvement was found only at high levels where surface properties deteriorated.

#### Comparative Example 3

In this example, the liquid silicone mold release agent, Dow QL-3677, was incorporated in the abrasion-resistant composition prior to its application to the face of the decor sheet. Again good results were not achieved.

#### Comparative Example 4

In this example, polytetrafluoroethylene ("Polyfluo® 190") having a congealing point of 250°F (121°C) was added to the abrasion-resistant composition before coating onto a decor sheet in an ultra-thin layer. The results were only fair. Excessive quantities of PTFE are necessary to obtain even moderate scuff resistance. Another disadvantage of PTFE is its high cost.

#### Example 1

To 64 gallons of water at 90°—105°F (32—40°C) were added slowly 6 pounds of carboxymethyl cellulose 7L (Hercules) with stirring until the CMC dissolved. Then 33.8 pounds (15—36 Kg) Avicel® RC791 (FMC) microcrystalline cellulose were added and the mixture was stirred until the viscosity reached 1900 mPas at 12 rpm. Next were added 33.8 pounds (15—36 Kg) of alumina WCA-30 (Microabrasives) and 300 ml silane A-100 (Union Carbide). The viscosity at this point was 2150 mPas. At this point, another 3.8 pounds (1.73 Kg) of carboxymethyl cellulose in 8

gallons (29 litres) of water were added, the viscosity then being 2100 mPas.

At this stage, an emulsion of 2.4 pounds (1.09 Kg) of dispersible polyethylene wax, Uniwax® 1050 (Durochemicals) in water were added, and the viscosity at this point was 1550 cps at 12 rpm. This composition was coated over the decor paper in an ultra-thin layer at the rate of 3—5 pounds per ream (5—8 g/m<sup>2</sup>). The ultra-thin coating was dried at a temperature greater than 140°F (60°C), but less than the melting point of the polyethylene wax. The so-coated decor sheet was treated with melamine resin to 50%—55% resin content and 5%—7% volatile.

The so-manufactured decor paper was assembled on a phenolic core and pressed normally at 1,000 psi (6.89 MPa) and 260°—300°F (127—149°C). The resultant laminate looked normal and had excellent abrasion-resistance as well as a low rate of wear, much lower than normal. The laminate surface was slick to the touch and did not scuff.

Attempts to scratch the laminate surface with sand were unsuccessful.

#### Example II

To 64 gallons (232 l) of water were added 4 pounds (1.8 Kg) of carboxymethyl cellulose 7L followed by mixing for 15 minutes. Next, 2.6 pounds (1.2 Kg) of micronized polyethylene wax (Shamrock® 394: MP 230°F (110°C); specific gravity 0.95; penetration less than 1; and average particle size approximately 12.5 µm, and 20 pounds (9.1 Kg) of Avicel® RC519 micro-crystalline cellulose were added and the mixture was stirred at a high shear until the viscosity was between 1500 and 2000 mPas at 12 rpm. Next, 24 pounds (10.9 Kg) of alumina WCA—30 and 435 ml of silane A—1100 were added. Finally, 8 gallons (29 l) of carboxymethyl cellulose mix containing 3.8 pounds (1.73 Kg) of CMC—7L were added and the pH was adjusted with 2.5 pounds (1.14 Kg) acetic acid.

The composition was coated onto core paper at 3—5 pounds per ream (5—8 g/m<sup>2</sup>) dry weight, the coating was dried without melting the wax, and decor paper was impregnated with melamine resin to 50%—55% resin content and 5%—7% volatile. The decor paper was used in the manufacture of a laminate and tested as in Example I, with results being the same.

Almost 200 sheets of laminate made according to Example II were processed. Laminate was handled similar to controls. Sheets were stacked in racks then pulled 10 at a time and packaged. Package was shipped to field terminal, inserted in rack, and withdrawn for examination. Experimental laminate experienced no damage. Controls ran between 11%—14% defective due to severe scuff marks depending on colour.

#### Example III

Method of Example II was repeated. The following waxes were tested with similar results:

AC 735	Allied Chemical Company
MPP123	Micro Powders
A—12	Allied Chemical Company
AC392	Allied Chemical Company
B6	Allied Chemical Company
Shamrock®395	Shamrock Chemical Company
MPP620	Micro Powders
AC316	Allied Chemical Company
AC540	Allied Chemical Company
MPP611	Micro Powders

AC735 is a micronized polyethylene homopolymer having a softening point (ASTM E—28) of 110°C and 230°F; a hardness (ASTM D—5) of 2.5 dmm; a density (ASTM D—1505) of 0.92 g/cc; and a Brookfield viscosity at 140°C (284°F) of 6,000 mPas.

Lubricant A—12 is a "Polymist" polyethylene fine powder, having a density of 0.99 g/cc; a hardness of 0.5 dmm (100 g/5 sec./25°C); a softening point of 140°C (284°F); an acid number of 30; an average particle size of 12 µm, and a particle size distribution of 2—24 µm.

Lubricant AC392 is an oxidized polyethylene homopolymer having a softening point of 138°C (280°F); a hardness of less than 0.5 dmm; a density of 0.99; a Brookfield viscosity of 9,000 mPas at 149°C (300°F); and an acid number of 28.

Lubricant B6 is another "Polymist", polyethylene fine powder, having a density of 0.96; a hardness of 0.5 dmm; a softening point of 128°C (262°F); an average particle size of 6 µm; and a particle size distribution of 2—12 µm.

Lubricant AC316 is another oxidized polyethylene homopolymer having a softening point of 140°C (284°F); a hardness of less than 0.5 dmm; a density of 0.98; a Brookfield viscosity of 30,000 mPas at 149°C (300°F); and an acid number of 16.

Lubricant AC540 is an emulsifiable ethylene/ acrylic acid co-polymer having a softening point of 108°C (226°F); a hardness of 2.0 dmm; a density of 0.93; a Brookfield viscosity at 140°C (284°F) of 500 mPas and an acid number of 40.

Lubricant MPP123 is a micronized polyethylene wax having a melting point of 230°—235°F (110—113°C); a congealing point of 215°—220°F (102—104°C); a penetration at 77°F (25°C) of 1.5; an acid and saponification value of 0; a density at 77°F (25°C) of 0.92; a maximum particle size of 15 µm and an average particle size of 4 µm.

Lubricant MPP620 is a micronized polyethylene wax, having a melting point of 241°F (116°C); a congealing point of 237°F (114°C); a penetration at 77°F (25°C) of 1; an acid and saponification value of 0; a density at 77°F (25°C) of 0.95; a maximum particle of 10 µm; and an average particle size of 2.5 µm.

Lubricant MPP611 is a micronized polyethylene wax, having a melting point of 232°F (111°C); a congealing point of 229°F (109°C); a penetration at 77°F (25°C) of 1; a density of 0.95; and an average particle size of 2.5 µm.

Lubricant Shamrock 395 is a high-melt polyethylene wax, having a high degree of crystal-

linity, a melting point of 250°F (121°C); a density of 0.95; and a penetration of less than 1.

#### Example IV

A series of tests were conducted in which web speed and oven temperature during drying of the ultra-thin abrasion-resistant coating on the decor sheet were adjusted so that the maximum web temperature reached was respectively 155°F (68°C), 222°F (106°C), and 238°F (114°C). In each case, the coat weight applied was about 4 pounds (1.8 Kg) per ream. The paper was saturated to a melamine resin content of 53%—55% and a volatile of 5.7%—6.5%. After pressing, each of the laminates were examined.

Paper run at 155°F (68°C) produced a laminate with excellent scuff resistance, deep, clear colour and no mottle. Paper run at 238°F (114°C) produced a laminate with poorer scuff resistance (still much than no wax), no mottle, but a frosty colour (i.e. the colour was not deep and rich). Paper run at 222°F (106°C), the wax melting point, had a spotty scuff resistance, a mottled appearance, and frosty colour.

From these runs, it is concluded that when wax is not melted during the drying of the abrasion-resistant coating, it is available to disperse during laminate pressing and "blooms" to the surface. The wax melting point should be sufficiently low so that it melts and "blooms" at the melting point of the impregnating resin, i.e. melamine or polyester, and before such resin gels. Higher melting point waxes may cause light scattering and a frosty appearance. If the wax melts in the coater, it saturates the paper fibres, preventing resin saturation and keeping the wax from blooming. This causes relatively poor scuff resistance, mottling, and a greying of colour.

For best results, the drying of the abrasion-resistant coating containing the lubricant should be at about 170°—190°F (77—88°C), above the minimum temperature 140°F and substantially below the melting point of the lubricant which is desirably 220°—230°F (104—110°C).

#### Example V

To 64 gallons (232 l) of water were added 4 pounds (1.8 Kg) of carboxymethyl cellulose 7L followed by mixing for 15 minutes. Next, 2.6 pounds (1.2 Kg) of micronized polyethylene wax (Shamrock 394: MP 230°F (110°C); specific gravity 0.95; penetration less than 1; and average particle size approximately 12.5 µm) and 20 pounds (9.1 Kg) of Avicel® RC591 microcrystalline cellulose were added and the mixture was stirred at a high shear until the viscosity was between 1500 and 2000 mPas at 12 rpm. Next, 8 gallons (29 l) of carboxymethyl cellulose mix containing 3.8 pounds (1.7 Kg) of CMC—7L were added and the pH was adjusted with 2.5 pounds (1.14 Kg) acetic acid.

The composition was coated onto solid colour decor paper at 1.5—2.0 pounds per ream (2.5—3.2 g/m²) dry weight, the coating was dried without melting the wax, and decor paper was impreg-

nated with melamine resin to 50%—55% resin content and 5%—7% volatile.

The so-manufactured decor paper was assembled on a phenolic core and pressed normally at 1,000 psi (6.89 MPa) and 260°—300°F (127—149°C). The resultant laminate looked normal and had normal abrasion-resistance. The laminate surface was slick to the touch and did not scuff. The laminate surface was scrubbed with detergent and warm water without reducing scuff resistance.

To 64 gallons of water at 90°—115°F (32—46°C) are added slowly 6 pounds (2.7 Kg) of carboxymethyl cellulose 7L (Hercules) with stirring until the CMC becomes dissolved.

Then, 33.8 pounds (15.4 Kg) Avicel® RC791 (FMC) microcrystalline cellulose are added and the mixture is stirred. At this point, another 3.8 pounds (1.54 Kg) of carboxymethyl cellulose in 8 gallons (29 l) of water are added.

Next, an emulsion of 3.4 pounds (1.5 Kg) of dispersible polyethylene wax, Uniwax® 1050 (Durochemicals) in water are added. This composition is coated over the decor paper in an ultra-thin layer at the rate of 1.75—2.9 pounds (0.8—1.3 Kg) per ream dry weight. The ultra-thin coating is dried at a temperature greater than 140°F (60°C), but less than the melting point of the polyethylene wax. The so-coated decor sheet is treated with melamine resin to 50—55% resin content and 5%—7% volatile.

#### Example VII

In place of microcrystalline cellulose as the primary temporary or surface binder, a number of Examples were carried out to demonstrate other compatible binders, such as sodium alginate (Kelgin® LV, of Kelco). Thus, a mixture of solid lubricant bound with sodium alginate can be coated on the decor paper, after which the paper is then saturated with melamine or polyester, and dried and made into a laminate. The surface of this laminate is slick and resistant to scuffing.

A solution was made up containing six parts of Kelgin® LV and six parts of polyethylene wax (Shamrock® 394) in 300 parts of water. This mixture was coated on a sheet of brown saturating paper at a rate of 1.5 to 2.0 pounds (0.7—0.9 Kg) per ream. The paper was saturated with melamine resin and laminated as in Example IV. The results were the same:

#### Example VIII

Additional examples were carried out to demonstrate the transfer technique consistent with EP—A—0,109,313 (priority 16.11.82, 02.09.83; filed 15.11.83; published 23.05.84).

Both the Kelgin® mixture described in Example VII and the Avicel® mixture of Example V were coated on release papers. These included aluminium foil on paper, as well as parchment. After drying, the release carrier was pressed in a normal cycle, coating down on a solid colour pattern sheet saturated with melamine. Normal phenolic core was used. Standard press cycles of



800—1200 psi (5.5 MPa—8.3 MPa) and 260°—300°F (127—149°C) were used. After the release carrier was removed, it was found that the coating had transferred to melamine coated paper. The resultant laminate was slippery and scuff resistant as above.

It is to be noted that, as used herein, 1 micron ( $\mu\text{m}$ ) equals  $10^{-6}$  m, 1 mil equals  $10^{-3}$  inch (25.4  $\mu\text{m}$ ) and 1 ream equals 3000 ft<sup>2</sup> (278.7 m<sup>2</sup>).

The present invention can also be used in conjunction with overlay paper rather than the decar sheet.

#### Claims

1. A facing sheet for use in the manufacture of scuff-resistant decorative laminates, said facing sheet having thereon an ultra-thin facing layer comprising

(1) a solid, particulate lubricant which melts and blooms to the surface under heat and pressure, and

(2) a binder material for said particles of lubricant to bind said particles to the surface of said facing sheet, said facing sheet being impregnated with a thermosetting resin compatible with said binder material.

2. A facing sheet according to Claim 1, in which the ultra-thin facing layer also comprises abrasion-resistant particles and the binder material binds the abrasion-resistant particles to the surface of the facing sheet.

3. A facing sheet according to Claims 1 or 2 wherein the lubricant has a particle size of up to 30  $\mu\text{m}$  and a melting point of 150°—285°F (65—140°C).

4. A facing sheet according to Claims 1 or 2 wherein the lubricant has a particle size of about 1—25  $\mu\text{m}$  and a melting point of 220°—230°F (104—110°C).

5. A facing sheet according to any one of the preceding claims wherein the lubricant is a polymer wax, suitably micronized polyethylene wax, having a particle size of 1—25  $\mu\text{m}$ .

6. A facing sheet according to any one of the preceding claims wherein the lubricant is present in an amount, based on the total weight of components of the ultra-thin facing layer, exclusive of said thermosetting resin of at least 2.5%.

7. A facing sheet according to Claim 6 wherein the lubricant is present in the ultra-thin facing layer in an amount of 0.175—0.5 pounds (0.28—0.81 g/m<sup>2</sup>) per ream of facing paper.

8. A facing sheet according to any one of the preceding claims wherein said binder material is microcrystalline cellulose, carboxymethyl cellulose, sodium alginate or mixtures thereof.

9. A scuff-resistant decorative laminate comprising a backing layer and laminated to a thermoset laminating resin-impregnated facing sheet according to any one of Claims 1—8.

10. A decorative laminate in accordance with Claim 9 wherein said ultra-thin layer has a calculated thickness of 0.05—0.3 mils (1.27—7.62  $\mu\text{m}$ ).

#### Patentansprüche

1. Deckschnicht zur Herstellung eines verschleißfesten Dekorlaminats, wobei die Deckschicht an ihrer Oberseite eine ultradünne Deckbeschichtung aufweist, umfassend

(1) ein aus Feststoffpartikeln bestehendes Gleitmittel, welches unter der Einwirkung von Hitze und Druck schmilzt und einen Feuchtigkeitsfilm ausbildet, und

(2) ein Bindermaterial für diese Gleitmittelteilchen, um die Teilchen an der Oberseite der Deckschicht zu binden, wobei die Deckschicht mit einem wärmehärtenden Harz imprägniert ist, welches mit dem Bindermaterial kompatibel ist.

2. Deckschicht nach Anspruch 1, wobei die ultradünne Deckbeschichtung auch abriebfeste Teilchen umfaßt und das Bindermaterial die abriebfesten Teilchen an der Oberfläche der Deckschicht hält.

3. Deckschicht nach Anspruch 1 oder 2, wobei das Gleitmittel eine Teilchengröße bis zu 30  $\mu\text{m}$  und einen Schmelzpunkt von 150° bis 285°F (65 bis 140°C) aufweist.

4. Deckschicht nach Anspruch 1 oder 2, wobei das Gleitmittel eine Teilchengröße von etwa 1 bis 25  $\mu\text{m}$  und einen Schmelzpunkt von 220° bis 230°F (104 bis 110°C) aufweist.

5. Deckschicht nach einem der vorhergehenden Ansprüche, wobei das Gleitmittel ein Polymerwachs ist, vorzugsweise feinstgemahltes Polyäthylenwachs, mit einer Teilchengröße von 1 bis 25  $\mu\text{m}$ .

6. Deckschicht nach einem der vorhergehenden Ansprüche, wobei das Gleitmittel in einem Anteil vorgesehen ist, welcher bezogen auf das Gesamtgewicht der Komponenten der ultradünnen Deckbeschichtung exklusiv des wärmehärtenden Harzes bei wenigstens 2,5% liegt.

7. Deckschicht nach Anspruch 6, wobei das Gleitmittel in der ultradünnen Deckbeschichtung in einem Anteil von 0,175 bis 0,5 Pfund pro Ries Deckpapier (0,28 bis 0,81 g/m<sup>2</sup>) vorhanden ist.

8. Deckschicht nach einem der vorhergehenden Ansprüche, wobei das Bindermaterial mikrokristalline Zellulose, Carboxymethylzellulose, Natriumalginat oder ein Gemisch hiervon ist.

9. Verschleißfestes Dekorlaminat umfassend eine Rückenschicht, welche auf eine Deckschicht laminiert ist, die mit einem wärmehärtenden Laminierharz imprägniert ist, nach einem der Ansprüche 1 bis 8.

10. Dekorlaminat nach Anspruch 9, wobei die ultradünne Schicht eine rechnerische Dicke von 0,05 bis 0,3 mil (1,27 bis 7,62  $\mu\text{m}$ ) aufweist.

#### Revendications

1. Feuille de revêtement à utiliser dans la fabrication de stratifiés décoratifs résistant au frottement, ladite feuille de revêtement portant une couche ultrafine de revêtement comprenant

(1) un lubrifiant en particules solides qui fond et resseue vers la surface sous chaleur et pression, et

(2) une matière liante pour lesdites particules



de lubrifiant, destinée à lier lesdites particules à la surface de ladite feuille de revêtement, ladite feuille de revêtement étant imprégnée d'une résine thermodurcissable compatible avec ladite matière liante.

2. Feuille de revêtement selon la revendication 1, dans laquelle la couche ultrafine de revêtement comprend également des particules résistant à l'abrasion et la matière liante lie les particules résistant à l'abrasion à la surface de la feuille de revêtement.

3. Feuille de revêtement selon les revendications 1 ou 2, dans laquelle le lubrifiant présente une dimension de particules pouvant s'élever à 30  $\mu\text{m}$  et un point de fusion de 150°—285°F (65—140°C).

4. Feuille de revêtement selon la revendication 1 ou 2, dans laquelle le lubrifiant présente une dimension de particules d'environ 1—25  $\mu\text{m}$  et un point de fusion de 220°—230°F (104—110°C).

5. Feuille de revêtement selon l'une quelconque des revendications précédentes, dans laquelle le lubrifiant est une cire de polymère, une cire de polyéthylène convenablement micronisée, ayant une dimension de particules de 1—25  $\mu\text{m}$ .

6. Feuille de revêtement selon l'une quelconque des revendications précédentes, dans laquelle le lubrifiant est présent en quantité d'au moins 2,5%, sur la base du poids total de constituants de la couche ultrafine de revêtement, à l'exclusion de ladite résine thermodurcissable.

7. Feuille de revêtement selon la revendication 6, dans laquelle le lubrifiant est présent dans la couche ultrafine de revêtement en quantité de 0,175—0,5 pound (0,28—0,81 g/m<sup>2</sup>) par rame de papier de revêtement.

8. Feuille de revêtement selon l'une quelconque des revendications précédentes, dans laquelle ladite matière liante est de la cellulose microcristalline, de la carboxyméthylcellulose, de l'alginate de sodium ou des mélanges de ces matières.

9. Stratifié décoratif résistant au frottement comprenant une couche de support et stratifié sur une feuille de revêtement imprégnée de résine stratifiante thermodurcissable, selon l'une quelconque des revendications 1—8.

10. Stratifié décoratif selon la revendication 9, dans lequel ladite couche ultrafine possède une épaisseur calculée de 0,05—0,3 mil (1,27—7,62  $\mu\text{m}$ ).

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